

WE CLAIM:

1. A laser system, comprising:
a laser producing a beam of output light;
a detector unit; and
a fringe -producing optical element disposed in the beam of output light to direct a portion of the beam of output light to the detector unit as a second light beam, an interference pattern being produced in the second light beam by the fringe-producing optical element.
2. A system as recited in claim 1, wherein the laser is a semiconductor laser.
3. A system as recited in claim 1, further comprising a light beam collimator disposed on the beam of output light between the laser and the fringe producing element so that the output light beam at the fringe-producing element is substantially collimated.
4. A system as recited in claim 1, wherein the second light beam includes a first component from a first side of the fringe-producing optical element and a second component from a second side of the fringe-producing optical element, the interference pattern being produces by interference between the first and second components.
5. A system as recited in claim 1, wherein the detector unit has at least three detector elements illuminated by respective portions of the interference pattern.

6. A system as recited in claim 5, wherein the respective portions of the interference pattern correspond to regions of different phase of the interference pattern.

7. A system as recited in claim 6, wherein there are n detector elements, n being greater than two, and the regions of different phase of the interference pattern are spaced apart by approximately $2\pi/n$.

8. A system as recited in claim 1, further comprising a reflector disposed between fringe-producing element and the detector unit to reflect the second light beam from the fringe producing element to the detector unit.

9. A system as recited in claim 1, wherein the fringe-producing optical element reflects the second light beam to the detector unit.

10. A system as recited in claim 9, wherein the fringe-producing element is a non-parallel etalon.

11. A system as recited in claim 10, wherein the non-parallel etalon is a non-planar etalon.

12. A system as recited in claim 10, wherein the non-parallel etalon is a wedged etalon.

13. A system as recited in claim 10, wherein the non-parallel etalon is a Fresnel etalon.

14. A system as recited in claim 10, wherein the non-parallel etalon is a binary etalon.

15. A system as recited in claim 9, wherein the fringe-producing element is a diffractive etalon.

16. A system as recited in claim 1, wherein the fringe-producing optical element transmits the second light beam to the detector unit.

17. A system as recited in claim 16, wherein the fringe-producing optical element is a diffractive etalon.

18. A system as recited in claim 1, further comprising an output optical fiber and a focusing unit disposed to focus a remaining portion of the output light beam into the optical fiber.

19. A system as recited in claim 1, further comprising a control unit coupled to receive light detection information from the detector unit and to determine an output power of the laser, the control unit further being coupled to the laser to stabilize the output power of the laser to a desired power level.

20. A system as recited in claim 1, further comprising a control unit coupled to receive light detection information from the detector unit and to determine a shift of an operating wavelength of the laser from a desired wavelength, the control unit further being coupled to the laser to tune the operating wavelength of the laser to the desired wavelength.

21. A system as recited in claim 1, wherein the second light beam has a power level of no more than about 10% of a power level of the output light beam incident on the fringe-producing element.

22. An optical communications system, comprising:

an optical communications transmitter unit having one or more laser units, at least one of the one or more laser units producing a laser output beam and having a wavelength stabilizing unit, the wavelength stabilizing unit including

a detector unit,

a fringe -producing optical element disposed in the laser output beam to direct a portion of the laser output beam to the detector unit as a second light beam, the fringe-producing optical element causing an interference pattern in the second light beam, and

a control unit coupled to receive detection signals from the detector unit and adapted to generate a laser frequency control signal for controlling wavelength of the at least one of the one or more laser units,

an optical communications receiver unit; and

an optical fiber communications link coupled to transfer optical communications signals from the optical communications transmitter unit to the optical communications receiver unit.

23. A system as recited in claim 22, further comprising a series of fiber amplifiers disposed on the optical fiber communications link, the series of fiber amplifiers including at least one fiber amplifier unit.

24. A system as recited in claim 22, wherein the optical communications transmission unit includes at least two laser units operating at different wavelengths and further comprising wavelength division multiplexing elements to combine light output from the at least two laser units to produce a multiple channel optical communications signal coupled to the optical fiber communications link.

25. A system as recited in claim 24, wherein the optical communications receiver unit includes wavelength division demultiplexing elements to separate the multiple channel optical communications signal into signal components of different wavelengths and further includes channel detectors to detect respective signal components.

26. A method of stabilizing an operating frequency of an output light beam produced by a laser, the method comprising:

deflecting a portion of the output light beam as a second light beam using a fringe-producing optical element, the fringe-producing optical element causing an interference fringe pattern in the second light beam;

detecting portions of the interference fringe pattern using a detector unit;

producing detector signals in response to the detected portions of the interference fringe pattern;

generating a frequency control signal in response to the detector signals; and

tuning the laser in response to the frequency control signal so that the operating frequency of the output light beam is substantially at a desired value.

27. A method as recited in claim 26, wherein deflecting the portion of the output light beam includes reflecting the portion of the output light beam using the fringe-producing optical element.

28. A method as recited in claim 27, wherein the fringe-producing optical element is a non-parallel etalon.

29. A method as recited in claim 28, wherein the non-parallel etalon is a wedged etalon.

30. A method as recited in claim 28, wherein the non-parallel etalon is a non-planar etalon.

31. A method as recited in claim 28, wherein the non-parallel etalon is a Fresnel etalon.

32. A method as recited in claim 28, wherein the non-parallel etalon is a binary etalon.

33. A method as recited in claim 27, wherein the fringe-producing optical element is a diffractive etalon.

34. A method as recited in claim 26, wherein deflecting the portion of the output light beam includes transmitting the portion of the output light beam through the fringe-producing optical element.

35. A method as recited in claim 34, wherein the fringe-producing optical element is a diffractive etalon.

36. A method as recited in claim 26, wherein deflecting the portion of the output light beam includes deflecting no more than about 10% of the output light beam.

37. A method as recited in claim 26, wherein deflecting the portion of the output light beam includes deflecting a first component from a first side of the fringe-producing optical element and deflecting a second component from a second side of the fringe-producing optical element, the second beam including the first and second components.

38. A method as recited in claim 26, wherein detecting the portions of the interference fringe pattern include detecting at least three different portions of the interference fringe pattern.

39. A method as recited in claim 38, wherein the at least three different portions of the interference fringe pattern correspond to regions of different phase of the interference pattern.

40. A method as recited in claim 39, wherein the regions of different phase of the interference fringe pattern are selected from more than one period of the interference fringe pattern.

41. A method as recited in claim 38, wherein the detector unit has n detector elements that detect respective portions of the interference pattern spaced apart by approximately $2\pi/n$.

42. A method as recited in claim 26, wherein generating the frequency control signal includes generating phase signals from the detector signals, and generating transformed phase signals using the phase signals and reference phase signals.

43. A method of stabilizing an operating frequency of an output light beam produced by a laser, the method comprising:

deflecting a portion of the output light beam as a second light beam using a fringe-producing optical element, the fringe-producing optical element causing an interference fringe pattern in the second light beam; and

stabilizing the operating frequency of the output light beam using the interference fringe pattern.

44. A method as recited in claim 43, wherein deflecting the portion of the output light beam includes reflecting the portion of the output light beam using the fringe-producing optical element.

45. A method as recited in claim 44, wherein the fringe-producing element is a non-parallel etalon.

46. A method as recited in claim 44, wherein the fringe-producing element is a diffractive etalon.

47. A method as recited in claim 43, wherein deflecting the portion of the output light beam includes transmitting the portion of the output light beam through the fringe-producing optical element.

48. A method as recited in claim 47, wherein the fringe-producing etalon is a diffractive etalon.

49. A method as recited in claim 43, wherein deflecting the portion of the output light beam includes deflecting no more than about 10% of the output light beam.

50. A system for stabilizing an operating frequency of an output light beam produced by a laser, the system comprising:

deflecting means for deflecting a portion of the output light beam as a second light beam, the deflecting means producing an interference fringe pattern in the second light beam; and

means for stabilizing the operating frequency of the output light beam using the interference fringe pattern.